

Field Report for Airborne Data Collected In Support of US EPA Region 6 KMCO Fire – Flight 2 3 April 2019

Background

On 2 April 2019 an explosion and subsequent fire was reported at the Kmco facility located near Crosby, TX. Local information indicated that at approximately 1155 (local) an isobutylene tank exploded and the resulting fire ignited a nearby warehouse. Reported onsite products include various glycols, anti-freeze, brake fluids and oil field products. The geographical coordinates of the facility are 29.9222N, 95.0547W (figure 1).

The US EPA Region 6 requested that the ASPECT system be deployed to provide monitoring support on 2 April 2019 and ASPECT completed the first of a 6 pass mission at 1303 local. IR imagery did not show a plume being emitted from the facility. Spectral data collected with the system FTIR showed compounds including acetone (1.7 ppm), ammonia (1.8 ppm), 1-butene (3.2 ppm), isobutylene (2.4 ppm) and isoprene (1.3 ppm). In addition, isobutylene was detected about 1.8 km southwest of the facility at a level of (1.7 ppm).

On 3 April 2019 the US EPA Region 6 requested that the facility be re-flown to assess the facility to determine if any emissions were still present at the facility. This report summarizes the finds of the mission.



Figure 1: KMCO Facility, Crosby, TX

ASPECT response to this Mission/Incident was in support of:

US EPA Region 6. OSC: Adam Adams and Matt Loesel

ASPECT System

The US EPA ASPECT system collects airborne infrared (IR) images and chemical screening data from a safe distance over the site (about 3,000 ft AGL). The system consists of an airborne high speed Fourier transform infrared spectrometer (FTIR) coupled with a wide-area IR line scanner (IRLS). The ASPECT IR systems have the ability to detect compounds in both the 8 to 12 micron (800 to 1200 cm⁻¹) and 3 to 5 micron (2000 to 3200 cm⁻¹) regions. The 8 to 12 micron region is typically known as the atmospheric window region since the band is reasonably void of water and carbon dioxide influence. Spectrally, this region is used to detect carbon - non-carbon bonded compounds. The 3 to 5 micron region is also free of water and carbon dioxide but typically does not have sufficient energy for use. This band does show use in high-energy environments such as fires. The carbon - hydrogen stretch is very common in this region.

A digital Nikon DX2 camera (12.4 mega pixel CMOS 3:5 aspect ratio, 28 mm wide-angle lens) collects visible aerial imagery as part of the core data product package. The camera timing system is connected to the primary IR sensors and provides concurrent image collection when other sensors are triggered. All imagery is geo-rectified using both aircraft attitude correction (pitch, yaw, and roll) and GPS positional information. Imagery can be processed while in flight or approximately 600 frames per hour can be processed once the data are downloaded from the aircraft.

An Imperx mapping camera (29 mega pixels; mapping focal plane array) provides a similar aspect ratio and aerial coverage. Like the Nikon DX2, it is connected to the primary IR sensors and provides concurrent image collection when other sensors are triggered. These images are often digitally processed in lower resolution, so they can be transmitted via satellite communication. The high-resolution images (>20 MB each) are pulled from the ASPECT after the sortie and are available at a later time.

All aerial photographic images collected by the ASPECT system are ortho-rectified and geospatially validated by the reachback team. In general, this consists of conducting geo-registration using a Digital Elevation Model (DEM) which promotes superior pixel computation and lessens topographic distortion. The image is then checked by a team member (using a Google Earth base map) for proper location and rotation.

Data is processed using automated algorithms onboard the aircraft with preliminary results being sent using a satellite system to the ASPECT reachback team for QA/QC analysis. Upon landing preliminary data results are examined and validated by the reachback team.

Weather Conditions and Crew Report

Weather for the mission is given in table 1.

Table 1. KMCO Fire Mission Weather 3 April 2019

Parameter	Surface (0900)
Wind direction	090 degrees
Wind speed	1 m/s (2 mph)
Temperature	21.7°C
Humidity	80%
Dew Point	12.2°C
Pressure	1004 mb
Ceiling	Unlimited

The crew reported that winds at altitude (2800 ft) were at about 15 kts (7.7 m/s) from the south. No emissions were observed from the facility.

Flight Status

The order to launch the aircraft was given at 0830 local on 3 April 2019 and the aircraft was airborne at approximately 0840. The initial data collection run over the site was at 0859 (local) The aircraft made a total of 5 data collection passes; flight information is summarized in Appendix A and Figure 2.

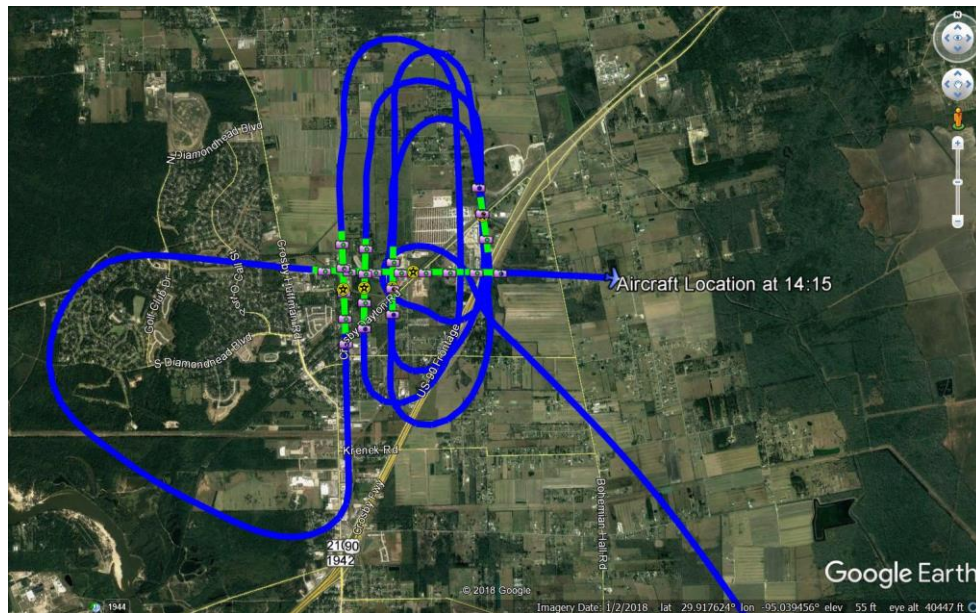


Figure 2: Data collection passes, KMCO Fire, Crosby, TX. The blue lines represent the ASPECT flight path, green lines represent when the FTIR was actively collecting data, the yellow icons with star is the centroid of the line scanner image, and the camera icons represent when a photo was taken.

Data Results Flight 3 April 2019

General Data Quality Objective

The following general data quality objectives are employed in conducting emergency response data collection with ASPECT:

1. To support overall situational analysis of the incident including aerial photography and IR imagery
2. To screen the incident for the presence of selected chemicals
3. To estimate the location and concentration of plumes being generated by the incident.

Line Scanner Data Results

A total of 1 test and 5 data passes were made in the proximity of the fire and an infrared line scanner image was generated for each pass. Figure 3 shows a 3-band infrared image obtained from data collected for Run 3. This image was generated by flying directly over the facility. Analysis of the images showed no significant elevated temperature areas and no plumes being emitted from the facility.

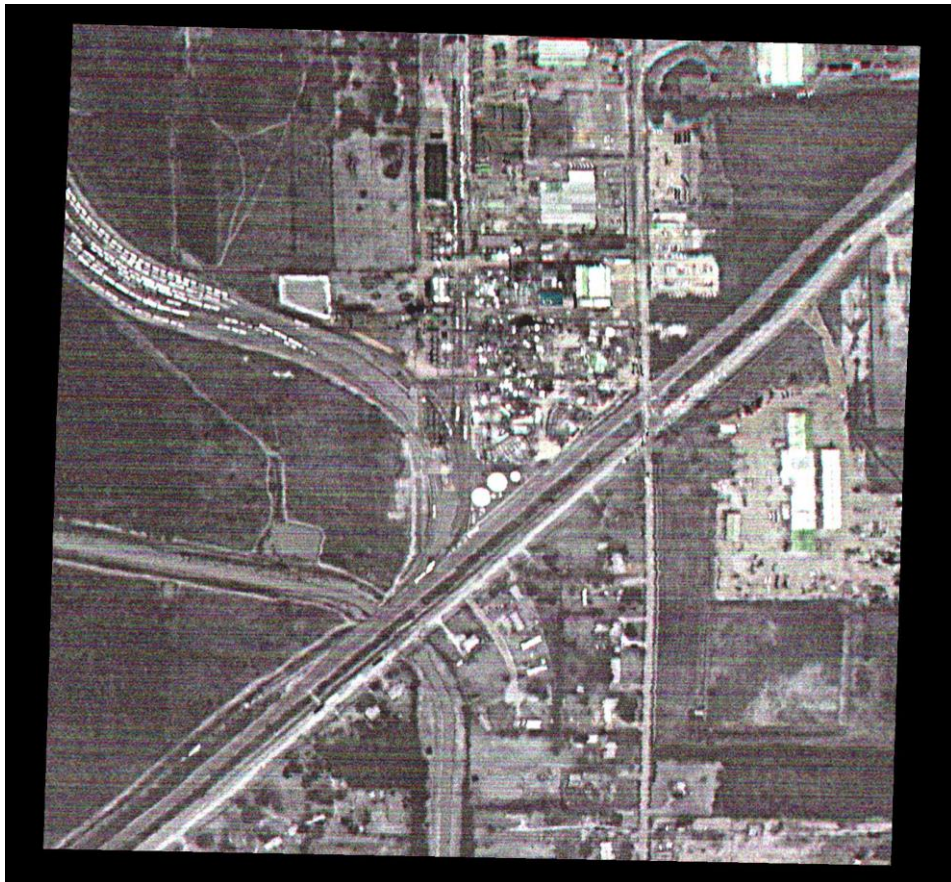


Figure 3: – 3 band IR image, KMCO Fire, Flight 2, Pass 3

FTIR Data Results

FTIR Spectral data at a resolution of 16 wavenumbers was collected for each pass. ASPECT uses an automated detection algorithm to permit compounds to be analyzed while the aircraft is in flight. 72 compounds are included in this algorithm and the list and associated detection limits are given in Table 2. In addition, collected data are also manually analyzed by comparing any detected spectral signatures to a collection of published library spectra. There were no detections on this mission.

No detections were observed on this flight. Details of the data collection are given in Table 3.

TABLE 2 - Chemicals Included in the ASPECT Auto-Processing Library

Acetic Acid	Cumene	Isoprene	Propylene
Acetone	Diborane	Isopropanol	Propylene Oxide
Acrolein	1,1-Dichloroethene	Isopropyl Acetate	Silicon Tetrafluoride
Acrylonitrile	Dichloromethane	MAPP	Sulfur Dioxide
Acrylic Acid	Dichlorodifluoromethane	Methyl Acetate	Sulfur Hexafluoride
Allyl Alcohol	Difluoroethane	Methyl Ethyl Ketone	Sulfur Mustard
Ammonia	Difluoromethane	Methanol	Nitrogen Mustard
Arsine	Ethanol	Methylbromide	Phosgene
Bis-Chloroethyl Ether	Ethyl Acetate	Methylene Chloride	Phosphine
Boron Tribromide	Ethyl Formate	Methyl Methacrylate	Tetrachloroethylene
Boron Trifluoride	Ethylene	MTEB	1,1,1-Trichloroethane
1,3-Butadiene	Formic Acid	Naphthalene	Trichloroethylene
1-Butene	Freon 134a	n-Butyl Acetate	Trichloromethane
2-Butene	GA (Tabun)	n-Butyl Alcohol	Triethylamine
Carbon Tetrachloride	GB (Sarin)	Nitric Acid	Triethylphosphate
Carbonyl Chloride	Germane	Nitrogen Trifluoride	Trimethylamine
Carbon Tetrafluoride	Hexafluoroacetone	Phosphorus Oxychloride	Trimethyl Phosphite
Chlorodifluoromethane	Isobutylene	Propyl Acetate	Vinyl Acetate

Table 3. Chemical Results Summary

Run	Date	Time (UTC)	Chemical	Max Concentration ppm
1	3 April 2019	0855	Test	Test
2		0859	ND	None
3		0903	ND	None
4		0906	ND	None
5		0910	ND	None
6		0913	ND	None
Note: ND = No Detections				

Aerial Photography Results

A full set of high resolution aerial digital photography were collected as part of the flight. Figure 4 shows an image collected as part of each pass. The burned area in the center of the facility is evident but no smoke is being emitted from the facility. Figure 5 shows an oblique collected during the flight. As with the aerial image, evidence of damage caused by the fire is present with no active smoke or emission being emitted from the facility.



Figure 4: Aerial Image of the KMCO Fire



Figure 5: Oblique Image of the KMCO Fire

Conclusions

On 3 April 2019 ASPECT was dispatched to conduct a follow up mission over the KCMO facility. IR imagery and spectral FTIR data showed no emissions or detections at or downwind of the facility

Appendix A

Abbreviations:

DEM – Digital elevation model
Alt – Altitude (in feet)
MSL – Mean sea level altitude (in feet)
Digital – Digital photography file from the Nikon D2X camera
MSIC – Digital photography file from the Imperx mapping camera
FTIR – Spectral IR data collected with a Fourier Transform
Infrared Spectrometer
IRLS – Infrared Line Scanner
Jpg – JPEG image format
UTC – Universal Time Coordinated
img – Spectral data format based on Grams format

Mission: 2019-04-03 KMCO Chem Fire

Date: 4/3/2019

Time UTC: 13:47

Aircraft Number: N9738B

Pilot: Beorn Ledger

Copilot: Todd Seale

Operator: Steve Brister

Aft Operator: Gerry Broyles

Ground Controller: Tim Curry

DEM: Using elevation from DEM Database

Run: 1 Time: 13:55:05 UTC

Alt: 1921 ft MSL Elev: 30 ft Elevation from DEM Database

Vel: 131 knots Heading: 329

Digitals: None

MSIC: 3

20190403135510845.jpg

20190403135518115.jpg

20190403135524464.jpg

FTIR: 1

20190403_135508_A.igm

IRLS: 1

2019_04_03_13_55_09_R_01 TA=7.1;TB=26.9;Gain=3

Gamma Runs: None

Run: 2 Time: 13:59:11 UTC

Alt: 2914 ft MSL Elev: 52 ft Elevation from DEM Database
Vel: 115 knots Heading: 349

Digitals: None

MSIC: 3

20190403135916884.jpg

20190403135923248.jpg

20190403135929597.jpg

FTIR: 1

20190403_135914_A.igm

IRLS: 1

2019_04_03_13_59_15_R_02 TA=6.2;TB=26.2;Gain=3

Gamma Runs: None

Run: 3 Time: 14:03:41 UTC

Alt: 2903 ft MSL Elev: 46 ft Elevation from DEM Database

Vel: 113 knots Heading: 179

Digitals: None

MSIC: 3

20190403140347429.jpg

20190403140353794.jpg

20190403140400143.jpg

FTIR: 1

20190403_140344_A.igm

IRLS: 1

2019_04_03_14_03_45_R_03 TA=4.6;TB=24.6;Gain=3

Gamma Runs: None

Run: 4 Time: 14:06:50 UTC

Alt: 2848 ft MSL Elev: 45 ft Elevation from DEM Database

Vel: 110 knots Heading: 179

Digitals: None

MSIC: 4

20190403140656280.jpg

20190403140702629.jpg

20190403140709898.jpg

20190403140716247.jpg

FTIR: 1

20190403_140653_A.igm

IRLS: 1

2019_04_03_14_06_54_R_04 TA=3.9;TB=24.0;Gain=3

Gamma Runs: None

Run: 5 Time: 14:10:01 UTC

Alt: 2906 ft MSL Elev: 44 ft Elevation from DEM Database

Vel: 109 knots Heading: 176

Digitals: None

MSIC: 5

20190403141006940.jpg

20190403141013290.jpg

20190403141019639.jpg

20190403141026003.jpg

20190403141032352.jpg

FTIR: 1

20190403_141004_A.igm

IRLS: 1

2019_04_03_14_10_04_R_05 TA=3.5;TB=23.5;Gain=3

Gamma Runs: None

Run: 6 Time: 14:13:40 UTC

Alt: 2678 ft MSL Elev: 47 ft Elevation from DEM Database

Vel: 109 knots Heading: 97

Digitals: None

MSIC: 8

20190403141346648.jpg

20190403141352997.jpg

20190403141359362.jpg

20190403141405711.jpg

20190403141412060.jpg

20190403141418425.jpg

20190403141425679.jpg

20190403141432043.jpg

FTIR: 2

20190403_141344_A.igm

20190403_141422_A.igm

IRLS: 1

2019_04_03_14_13_44_R_06 TA=3.9;TB=23.9;Gain=3

Gamma Runs: None